News Release

Unlocking algal secrets may help clean up radioactive isotopes

ARGONNE, Ill. (November 29, 2011) — In 1963, Dr. Louise Reiss completed a study of thousands of baby teeth collected from children born in the 1950s and '60s that showed the world that fallout from weapons testing was accumulating in humans.

She had tested the teeth for strontium-90, a radioactive isotope so similar to calcium that our bones can use it as a building block instead. But 50 years after her discovery, we still have no good way to clean up strontium-90.

Using the Advanced Photon Source at the U.S. Department of Energy's Argonne National Laboratory, a group of Northwestern University and Argonne scientists have figured out the secrets of algae that can preferentially take up strontium over calcium—a task so difficult that it's not easily done even in a laboratory.

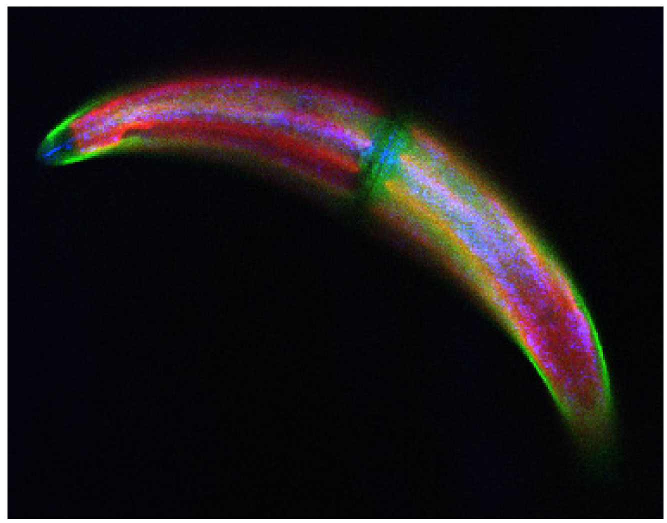
The algae could form the basis of new technologies to clean up contaminated land or water.

Strontium-90 is one of the deadly isotopes produced by nuclear weapons and reactors. If it's ingested in contaminated food or water, the human skeleton may take it up instead of calcium—where it can sit for decades, poised to trigger bone cancer or leukemia.

"The difficulty with cleaning up strontium-90 from the environment is that it's so similar to calcium and barium that scientists even have trouble doing it in the laboratory, with sophisticated equipment," explained lead author Minna Krejci, who has a joint appointment at Northwestern and Argonne. "The ability to differentiate the two is rare even in nature. This green alga is one of the few organisms with that ability."

Biologists had discovered that the green algae Closterium moniliferum forms crystals using strontium isotopes, but no one knew how.

Krejci and the team used a type of imaging called X-ray



Confocal microscopy of C. moniliferum*, an algae that takes up strontium and could be used in cleaning up radioactive contamination. Image courtesy Minna Krejci/Joester Laboratory of Northwestern University.*

fluorescence microscopy to track the movement of metals through the components of a cell. By comparing the data with physical photos of the cells taken with an electron microscope, they found that high concentrations of sulfur in the vacuoles—the cell's storage compartments— meant more strontium pulled up into crystals. This type of mechanism is called a sulfate trap.

If the mechanism could be harnessed, the algae could be released in contaminated areas to sequester the strontium, the researchers suggested. Previously, even the best known methods for removing strontium-90 pulled in too much calcium along with the strontium to be efficient. Methods for removing strontium might also someday be useful in recycling nuclear fuel.

...continued

The discovery is also useful in the context of learning how organisms use metal atoms in everyday functions.

"About a third of the proteins in your body interact with metals; for example, iron in blood cells and calcium in bone" explained Argonne physicist Lydia Finney. "It's a rapidly developing area of science, and the techniques we've developed at the APS are really helping it to grow."

The Advanced Photon Source is one of just a few places in the world that can perform this kind of subcellular imaging.

Argonne scientist Stefan Vogt and Northwestern assistant professor Derk Joester advised Krejci on the project. Other collaborators include Brian Wasserman at Northwestern and Ian McNulty, Daniel Legnini and Stefan Vogt with Argonne. The work was published in a study, "Selectivity in biomineralization of barium and strontium", and featured on the cover of the Journal of Structural Biology. More details are available at the APS website.

The research was supported by Northwestern University. Confocal microscopy was performed at the NU Biological Imaging Facility. Scanning electron microscopy was performed at Northwestern's NUANCE Center, supported by the National Science Foundation, the Keck Foundation, the State of Illinois, and Northwestern University, as well as at the Electron Microscopy Center of ETH Zürich. Use of the Advanced Photon Source at Argonne National Laboratory was supported by the DOE's Office of Science, Office of Basic Energy Sciences.

The U.S. Department of Energy's Argonne National Laboratory seeks solutions to pressing national problems in science and technology. The nation's first national laboratory, Argonne conducts leading-edge basic and applied scientific research in virtually every scientific discipline. Argonne researchers work closely with researchers from hundreds of companies, universities, and federal, state and municipal agencies to help them solve their specific problems, advance America's scientific leadership and prepare the nation for a better future. With employees from more than 60 nations, Argonne is managed by UChicago Argonne, LLC for the U.S. Department of Energy's Office of Science.

By Louise Lerner.

CONTACT ▸ Louise Lerner | 630-252-5526 | media@anl.gov | Media Relations | www.anl.gov